

flattened base, enlarged $\times 20$, and the micropyle enlarged $\times 250$. The irregular stopping of the ribs of the ovum and the somewhat ill-defined micropyle, are very apparent in the latter.

The Oothecæ of Blattidæ.

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The egg-capsule or ootheca of the common pest of our kitchens *Blatta orientalis*, is a familiar enough object, which requires no detailed description here. Enough to say that it is composed of hard, brown chitin, and in cross-section is rather pear-shaped, the thin end of the section corresponding to the upper edge of the capsule. The upper edge is marked by a notched crest and the crest itself shows the line of dehiscence of the ootheca, this line extending about half-way down the two ends of the capsule. The notches in the sutural crest are said to indicate the number of embryos contained in the ootheca, but this is not really true. The embryos lie head uppermost in a double row, and their position and number is shown by grooves and bulgings of the sides of the capsule, beneath the sutural crest. This is clearly shown in the ootheca of *Periplaneta americana*, which is closely similar to that of *Blatta orientalis*: in this specimen the notches number thirteen, which would indicate twenty-six embryos, whereas really the number of embryos is sixteen, there being eight on each side of the ootheca, as shown by the slight excrescences below the sutural crest. The lips of the suture are not soldered together in any way, but remain closely appressed by virtue of the elasticity of the chitinous walls, whilst the sculpturing and puckering of the crest doubtless play a sort of interlocking action.

It has been stated that the young larvæ escape from the capsule by exuding a fluid which dissolves the material soldering together the lips of the suture. This is very doubtful; the young larvæ are provided with a pair of frontal vesicles which, by means of an alteration of blood pressure, can be enormously dilated, thus rupturing any covering, membrane, or egg-case. This method of escape from egg or egg-case is practically universal in the insect kingdom, though the position of the vesicle or vesicles varies; in the cockroach the so-called ocelli mark the position of these vesicles in the young larvæ.

Very similar to the Blattine type is the little ootheca, which belongs to an unknown Ceylon species, probably of the subfamily *Pseudomopinae*: it is attached to the upper surface of a leaf and the actual specimen, which is white mottled with brown, looks singularly like a drop of bird's excrement. Quite different is the really elegant egg-capsule of *Megaloblatta rufipes*, one of the *Nyctiborinae*, a subfamily confined entirely to the New World. The sutural crest is toothed and the sides of the capsule are beautifully striated; the number of contained eggs appears to be forty, judging by the grooving of the sides. The capsule is much flattened from side to side and is carried with the suture directed to one side, thus differing markedly from the Blattine position. The very similar ootheca of *Paratropes bilunata* which I found in the British Museum collection confirmed an opinion previously formed, *viz.*, that this genus should be removed from the *Epilamprinae* and placed in the *Nyctiborinae*.

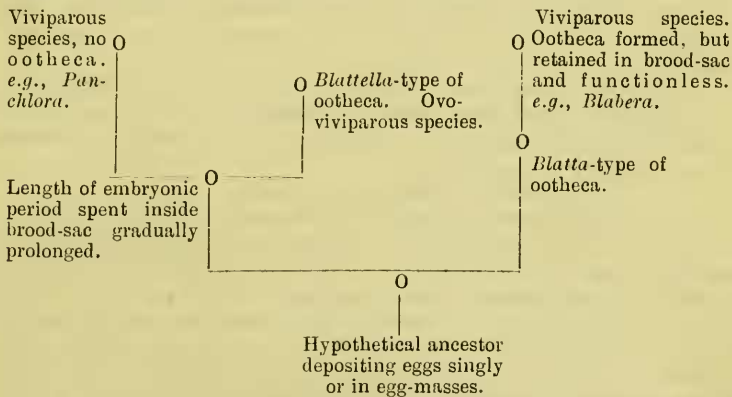
The egg-case of *Polyphaga aegyptiaca* (sub-family *Corydiinae*) has been figured by Brunner von Wattenwyl in his *Prodromus Europäischen Orthopteren* (pl. i., fig. 12 C.); it is chiefly remarkable for being furnished with a peculiar flange or spur at the posterior end of the sutural crest, which is deeply notched; it is not so rotund as the typical Blattine ootheca, but is rather intermediate in shape between such an one and that of *Megaloblatta*. There is no information as to the way in which the ootheca is carried, *i.e.*, with the suture uppermost or directed to one side.

The corresponding Neotropical genus *Homocogania* has a very peculiar ootheca, if one may take that of *H. azteca* as an example. In shape it is not unlike that of *Paratropes bilunata*, but along the lower border on each side runs a thin flange, leaving between them a deep groove. The capsule is carried in the same way as in the *Nyctiborinae*.

On account of the egg-laying habits of the *Blattidae* and *Mantidae*, Handlirsch, the learned Viennese entomologist, has brigaded together these two families of Orthoptera, christening them the *Blattaeformia Oothecaria* and regarding them as the most primitive of all the families. From an anatomical point of view this opinion may be correct, but it is a mistake to suppose that all *Blattidae* form an ootheca. The case is far otherwise, and I can state with confidence that about one-third of the genera form no ootheca at all, or only a most imperfect one, the young larvæ emerging alive from the brood-sac of the mother. The viviparous habit amongst cockroaches was first discovered by Riley in *Panchlora viridis*, and numerous other examples have come to light since then. In most of these viviparous species the embryos are carried in the brood-sac of the mother enveloped in a thin membrane, which ruptures to let the embryos escape. But yet another method has been observed by Holmgren of species belonging to three subfamilies, *viz.*, *Oxyhaloa saussurei* (*Oxyhaloinae*), *Eustegasta micans* (*Epilamprinae*), and *Blabera* sp. (*Blaberinae*). In the last species a chitinous, sculptured capsule is formed and is retained in the brood-sac until the young are ready to emerge, when apparently it is deposited. In *Eustegasta* on the other hand the capsule splits open inside the brood-sac allowing the young to escape before the ootheca itself is actually got rid of. This type of viviparity is evidently secondary to the formation of a chitinous ootheca, or in other words, is derived from it, for it is not reasonable to suppose that an elaborate structure like the ootheca of *Megaloblatta rufipes* should have been developed if it was never to be exposed to view. It is far more likely that the *Eustegasta* and *Blabera* type of egg-laying is a secondary device to secure still greater immunity from the attacks of parasites, and it is no wild supposition that in course of time the chitinous ootheca, being in these species a work of supererogation, will disappear. The viviparity of *Panchlora* and *Panesthia* is another matter; it may be primitive, it may be derived from the *Eustegasta* type or from yet another type of ootheca, *viz.*, that shown by *Blattella germanica* and other *Pseudomopinae*. The ootheca of *B. germanica* is a thin leather sac, and carried with the suture, which is not marked with any crest, directed to one side, the number of contained eggs is rather large and therefore the length of the sac is considerable. The sutural line is marked by a series of puckers and the number of eggs is about fifty. This structure is carried in a brood-sac and protruding from

the apex of the abdomen until the embryos are just about ready to emerge, when it is deposited in a casual manner anywhere. It is obvious that this type of ootheca is not derived from the chitinous type but is merely an advanced development of the thin membrane surrounding the egg-masses of *Panesthia*, *Panchlora*, etc.

Now, which is the more primitive habit in the *Blattidae*, viviparity or the ootheca-forming habit? This is a problem which cannot be solved with certainty, but I believe that viviparity has in this family a two-fold origin. In *Blabera* and *Eustegasta* it is secondarily derived from the ootheca-forming habit, as shown by the presence of a more or less junctionless ootheca in these genera; in *Blattella* it may well be derived from an ancestral type, which deposited an egg-mass at the beginning of the embryonic period. The Blattine ootheca, elaborate as it is in structure, can hardly be regarded as truly primitive, and the fact that it attains its highest development in the *Nyctiborinae* and *Blattinae*, two highly evolved subfamilies, is further confirmation of the opinion that this structure came into being at a period comparatively late in the cockroach genealogical history. The following diagram may make matters a little more clear.



Whether there is a grain of truth in this diagram or not, one thing is clear and that is, that the various adaptations of habit and oothecal structure are designed with the object of securing protection from the attacks of external parasites. The appearance of these enemies would soon render the position of unprotected eggs untenable and two methods of protection could be adopted, either the eggs must be retained inside the mother as long as possible, or they must be concealed in a horny chitinous covering; both methods have met with success, but of the two the former seems to be the more successful, seeing that the *Blabera* type of viviparity is secondarily derived from the habit of forming a true and functional ootheca, and presumably is so derived because of its greater value to the species.

It only remains to give now a list of the sub-families and genera in which the egg-laying habit is known. The *Blattidae* are divided into sub-families, and the egg-laying habits are known in a certain proportion of genera in each sub-family, except the *Perisphaerinae* concerning which we are almost quite ignorant. The following are the sub-families and genera about which we have some information:—

SUB-FAMILY ECTOBIINÆ.—Ootheca chitinous, of Blattine type. Known in the following genera:—*Ectobius*, *Theganopteryx*, *Hololampra*.

SUB-FAMILY PSEUDOMOPINÆ.—Ootheca either of Blattine type, or leathery and carried with the suture directed to one side. Known in the following genera:—

1. Blattine type, *Ellipsoidion*, *Mareta*.

2. Leathery form, *Hemithyrocera*, *Blatella*, *Ischnoptera*, *Loboptera*.

SUB-FAMILY NYCTIBORINÆ.—Chitinous ootheca of peculiar type. Known in the following genera:—*Megaloblatta*, *Paratropes*.

SUB-FAMILY EPILAMPINÆ.—Viviparous, ootheca represented by a membrane, which may, or may not, be retained in the brood-sac. Known in the following genera:—*Phlebotonus*, *Molytria*, *Pseudophoraspis*, *Epilampra*, *Eustegasta*.

SUB-FAMILY BLATTINÆ.—Chitinous ootheca carried with suture uppermost. Known in the following genera:—*Polyzosteria*, *Blatta*, *Periplaneta*, *Pseudoderopeltis*, *Deropeltis*.

SUB-FAMILY PANCHLORINÆ.—AS IN EPILAMPINÆ. Known in following genera:—*Gyna*, *Rhyparobia*, *Leucophaea*, *Panchlora*, *Nauphoeta*.

SUB-FAMILY BLABERINÆ.—Chitinous ootheca formed, but never extruded, practically functionless. Known in following genus:—*Blabera*.

SUB-FAMILY CORYDIINÆ.—Chitinous ootheca of modified Blattine type. Known in following genera:—*Polyphaga*, *Homoeogamia*.

SUB-FAMILY OXYHALOINÆ.—Viviparous or with chitinous ootheca. Known in following genera:—

(i.) Viviparous. *Oxyhaloa*, *Diploptera*.

(ii.) Chitinous ootheca. *Chorisoneura*, *Ectoneura*.

SUB-FAMILY PERISPHAERINÆ.—The only evidence that we have about the egg-laying habit of this sub-family, and that but indirect, is that supplied by Mr. Distant in his "*Insecta Transvaaliensia*" concerning *Cyrtotria* (*Stenopilema*). A female of the species was found living in a burrow in the ground surrounded by its young; this is slight evidence in favour of a viviparous habit, for the necessity of forming a horny capsule is obviated by the cryptic habit, and no trace of such a capsule empty seems to have been found, and it is highly unlikely that a cockroach should lay eggs, like the earwig and mole-cricket, entirely unprotected by an ootheca of some sort.

SUB-FAM. PANESTHIINÆ.—Viviparous. Ootheca a mere membrane. Known in the following genera:—*Panesthia*, *Salganea*.

It is quite evident that the egg-laying habits can be of considerable use in any scheme of classification of the Blattidae. The discovery of the ootheca of *Paratropes* was definitive evidence in favour of the inclusion of this genus in the Nyctiborinae, and the oscillations of *Hemithyrocera* between the Ectobiinae and Pseudomopinae are brought to an end by the discovery that its ootheca is similar to that of *Blatella*. It will be noted that so far as our present knowledge goes, the egg-laying habit is diverse in only two sub-families, the Pseudomopinae, in which a leathery capsule and a chitinous capsule is formed, and the Oxyhaloinae, which exhibit viviparity and the chitinous ootheca; certainly the latter sub-family is no natural one, and could well be split into two, but whether the Pseudomopinae lend themselves to the same treatment cannot be decided.

Occasionally a female cockroach may be captured with an ootheca protruding from the apex of the abdomen and it will be noticed that the position of the capsule between the lips of the valvular subgenital lamina (last ventral plate) is such that the suture of the capsule is uppermost. The female carries the capsule thus protruding from the end of her body for seven or eight days, and then deposits it in some secure nook or cranny, either wedging it into a crack or else with a drop of some glutinous material making it adhere slightly to some foreign substance.

The most important cockroach-parasites are the species of the Hymenopterous genus *Evania*, curious looking insects with the abdomen small, triangular, much flattened from side to side, and slung to the thorax by a slender pedicel. The *modus operandi* of the parasite has, so far as I know, not been observed, but it is tempting to suppose that the female can slip her cleaver-like abdomen between the lips of the oothecal suture, and so right into the ootheca itself; so hard and horny is the capsule that the suture appears to be the only part susceptible to attack.

The egg-cases of *Periplaneta americana*, the well-known "ship's cockroach," and *P. australasiae* are very similar to that of *B. orientalis*. Both are abundant household pests in the tropics. It is concerning certainly one of these two species that the following observations were made in West Africa by Col. Wynn Sampson:—"Ootheca is similar to the English one, but apparently the female is not satisfied with the protection it affords to the egg, and she therefore not only covers it over, but also uses the material of the substance to which the ootheca is attached for this purpose. One specimen, for instance, was half embedded in the top of a cork, and chips of cork completely covered the capsule; another was stuck on the edges of the leaves of a book and was covered with fragments of paper; another on the leather binding of a book was covered with fragments of leather; whilst a fourth example was fastened to some mortar between two bricks, and was actually covered with mortar." It is not without interest to note that De Geer, quoting Madame Merian on the habits of *Periplaneta americana*, says that they cover their egg-cases with a "toile fine"; De Geer doubts the accuracy of his informant's observations, but it is quite possible that Madame Merian was attempting to describe a habit which has not been observed again for over a century.

The egg-case of *Deropeltis autraniana* protrudes from the abdomen of the female. The distortion, due to drying, shows that the ootheca is more of a leathery consistency, and in this feature, together with its greater length, it differs from those already described. It may be noted here that the formation of the ootheca is gradual, proceeding from backwards before, and the more advanced it is in development the further it extrudes.

Notes on a July trip to Switzerland.

By B. S. CURWEN.

On July 5th I started for a twenty-five days' tour in Switzerland, and as the weather was very fair, compared with the subsequent weird meteorological happenings in August, and as butterflies were found to be comparatively plentiful, a short account of my captures may prove of interest. With me were a friend and my brother, neither of whom,